

**What is claimed is:**

1. A method for decomposing methane to hydrogen and carbon and substantially no carbon oxides, which method comprises contacting, at a temperature from about 425°C to about 625°C, methane with a catalyst represented by the formula:



$\text{Ni}_x\text{Mg}_y\text{O}$ , wherein x and y reflect the mole content of Ni to Mg respectively, and wherein the molar ratio of Ni to Mg is from about 1 to 1 to about 6.2 to 1, and the percentage of Ni in the metallic state is from about 15% and up to about 95%, and the percentage of Ni, of the metallic Ni, in the active state is greater than about 25%.

2. The method of claim 1 wherein the molar ratio of Ni to Mg is from about 1.8 to 1 to about 2.8 to 1.
3. The method of claim 2 wherein the molar ratio of Ni to Mg is from about 2.0 to 1 to about 2.8 to 1.
4. The method of claim 1 wherein the percentage of Ni in the metallic state, based on the total amount of Ni is from about 55% to 80%.
5. The method of claim 1 wherein the temperature at which methane decomposition takes place is from about 475° to about 575°C.
6. The method of claim 5 wherein the temperature at which methane decomposition takes place is from about 500° to about 550°C.
7. A method for decomposing methane to hydrogen and carbon and substantially no carbon oxides, which method comprises contacting, at a temperature from about 500°C to about 800°C, methane with a catalyst represented by the formula:

$\text{Ni}_x\text{Mg}_y\text{Cu}_z\text{O}$ , wherein x, y, and z represent the mole content of Ni, Mg, and Cu respectively;

the molar ratio of Ni to Cu is about 19 to 1 to about 1 to 1;

the molar ratio of Ni to Mg of about 1.0 to 1 to about 6.2 to 1; and

the percentage of Ni and Cu in the metallic state is from about 15% to 95%, and the percentage of Ni, of the metallic sites, in the active state is greater than about 25%.

8. The method of claim 7 wherein the molar ratio of Ni to Cu is about 4 to 1.

9. The method of claim 7 wherein the molar ratio of Ni to Mg is from about 1.8 to 1 to 2.8 to 1.

10. The method of claim 9 wherein the molar ratio of Ni to Mg is from about 2.0 to 1 to about 2.8 to 1.

11. The method of claim 7 wherein the percentage of Ni in the metallic state, based on the total amount of Ni is from about 55% to 80%.

12. The method of claim 7 wherein the temperature at which methane decomposition takes place is from about 600° to about 775°C.

13. The method of claim 12 wherein the temperature at which methane decomposition takes place is from about 700° to about 760°C.